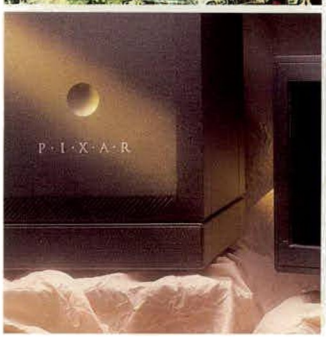

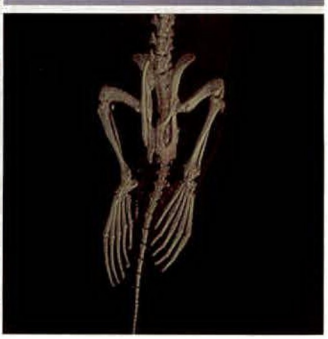

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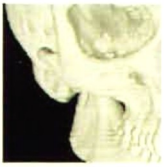
Pixar Image Computers

Contents



Introduction 2

Applications

Scientific visualization 6

Remote sensing and mapping 8

Medical imaging 10

Graphic arts and design 12

Products

Image computer family 14

Software 22

Third party products 30

Sales and technical support 31

Glossary 32

Pixar®: A company chronology

1979: Pixar begins as the Computer Division of Lucasfilm Ltd.

Dr. Ed Catmull, director of the Computer Graphics Laboratory at the New York Institute of Technology, is recruited by George Lucas to develop computer graphics technology for the film industry. Shortly after, Dr. Catmull recruits Dr. Alvy Ray Smith, a former colleague, and together, they assemble the team that will become the creative force behind Pixar. Dr. Catmull will become president of Pixar and Dr. Smith, executive vice president.

1979-1985: Pixar's forerunner applies technology to film production.

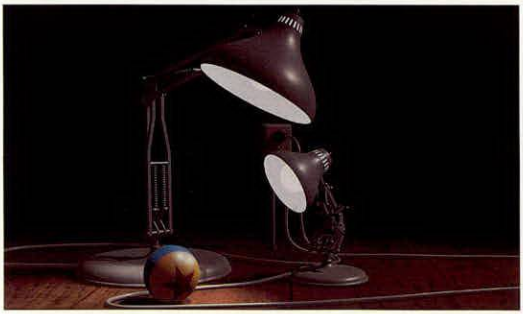
Research conducted by the Computer Division leads to development of computer-generated images of such realism that they can be convincingly combined with live-action photography. Sequences of computer animation are produced for *Star Trek II: The Wrath of Khan, The Return of the Jedi,* and *Young Sherlock Holmes.* The technologies used at Lucasfilm ultimately lead to the development of the Pixar Image Computer™.

1986: Pixar spins off: The Pixar Image Computer is brought to market.

Recognizing the potential for general-purpose image computing outside the film industry, the Computer Division spins off from Lucasfilm in February of 1986 and is renamed Pixar. The division is acquired by Steven P. Jobs and the employees of Pixar, with the goal of pursuing commercial and industrial applications. The entire research and development team remains intact. Pixar systems quickly integrate into such diverse application areas as CT reconstruction, satellite image analysis, non-destructive testing, simulation, and high-quality animation.

1988: Pixar II™ introduced.

The recently introduced Pixar II reflects an on-going commitment to customers and developers to make Pixar's technology and software available for a broad range of visualization applications at an affordable price.



The Road to Point Reyes *landscape was the first very detailed modeling of a complex scene using patches, polygons, fractals, particle systems and a variety of procedural models.* ©*1983 Pixar.*

The Adventures of André and Wally B. *introduced character animation to computer graphics. Realism was added to the film using motion blur, which accurately blurs moving objects in each frame of movement.* © *1984 Pixar.*

Luxo Jr. *was the first three-dimensional computer-animated film to be nominated for an Academy Award. Luxo Jr. introduced self-shadowing, where an object accurately projects shadows upon itself.* ©*1986 Pixar.*

Visualization: A method for seeing the unseen

Pixar's mission is to advance science, medicine, engineering, and art through the technology of visualization. According to a National Science Foundation (NSF) report, "Visualization . . . offers a method for seeing the unseen. It enriches the process of scientific discovery, and is revolutionizing the way scientists do science."[1]

An answer to information overload

New technologies are producing an ever-increasing amount of data. Satellite imaging of the earth, remote-sensing studies of geology, and medical CT scans, for example, all result in prodigious quantities of data. Often, this cannot be optimally interpreted when it is presented in the form of text or plots. But organizing such data by computer to create highly realistic, full-color images on the screen allows the observer to visualize the data and interact with it directly. The result is a better understanding of the data's true significance.

Beyond basic image processing

Pixar provides the benefits of visualization through the advanced technology of "image computing." The Pixar family of image computers provides a powerful new creative and interpretive tool by combining image processing techniques for the analysis and manipulation of real-world data from such technologies as CT scanners and remote sensors, with the image synthesis and simulation made possible by advanced computer graphics. Indeed, the Pixar image computers are creating an entirely new definition of what image computing can be.

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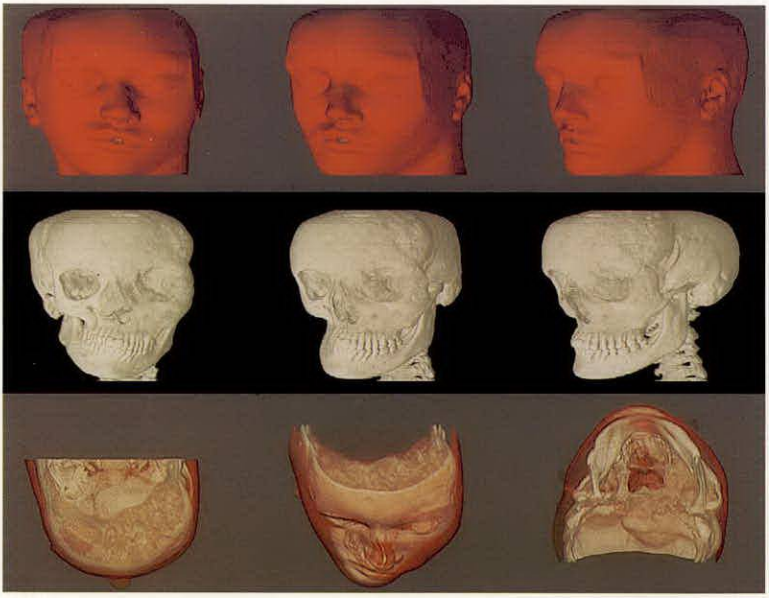
[1] *Visualization in Scientific Computing*. Report of the NSF Advisory Panel on Graphics, Image Processing and Workstations, 1987, McCormick, Defanti and Brown, Editors.



These reconstructions of a patient with an abnormal growth of the skull were made by processing CT data with the Pixar Image Computer. Top reconstruction shows the skin of the patient. Middle reconstruction shows the bone tissue. Bottom images are cut-aways revealing thickening of the bone behind the patient's forehead. Such views offer a valuable way for doctors to monitor the progress of the disease. Data courtesy of The University of Pittsburgh Eye and Ear Hospital.

Helping scientists through visualization applications

Visualization in scientific computing can bring enormous leverage to bear on scientific productivity and the potential for major scientific breakthroughs.

—from the report to the NSF by the panel on Graphics, Image Processing and Workstations.

In such diverse fields as astrophysics, fluid dynamics, chemistry, biology, non-destructive testing and geophysics, scientists and engineers need a visual aid to interpret experimental results, evaluate simulations, and formulate new experimental approaches. Pixar image computers are designed to meet this important visual need.

Realistic images from raw data

Pixar image computers provide the means to visualize volumetric, surface, and image data gathered from a variety of sources—including supercomputers, satellites, digital acquisition devices, laboratory experiments or large databases. Pixar image computers enhance this raw data and then quickly synthesize it into complex, realistic images. These images are unlike any produced by traditional techniques that represent objects merely as geometric models based on surfaces. Instead, they represent a computerized visualization of the data that can be further enhanced to show important variables such as temperature, or the progress of events over time.

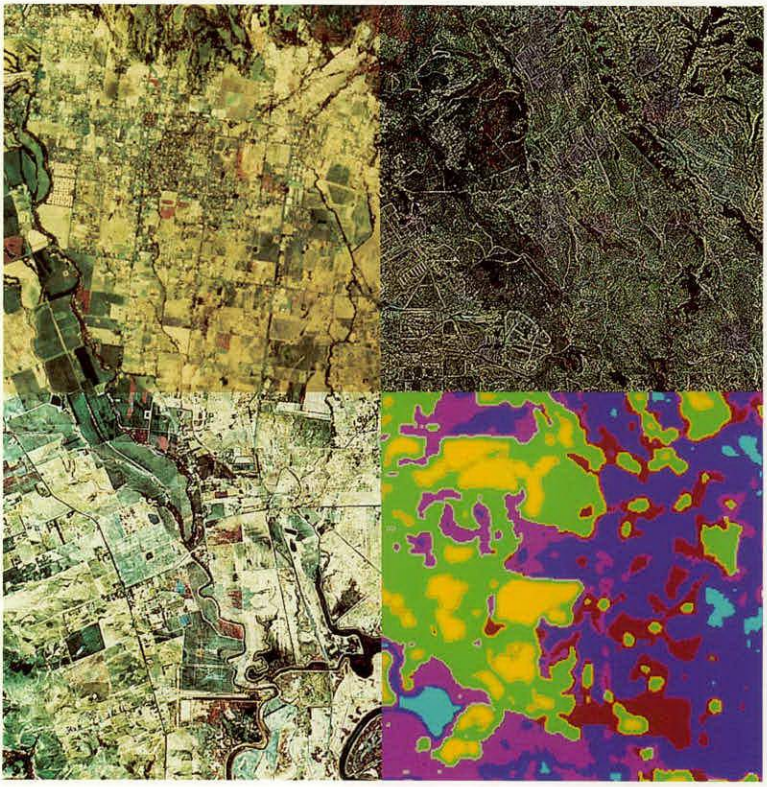
Internal air passages used for cooling this turbine blade are shown in blue in this volumetric reconstruction from CT slices. The blade has a manufacturing flaw that has resulted in the passage being blocked. Such a blockage could not be detected by viewing the actual part. Data courtesy of General Electric Aircraft Divison.

Applications in remote sensing and mapping

Massive amounts of information are captured by remote sensors—satellites, aerial photography, radar, and ground sensors—for the purpose of analysis and interpretation. Pixar's image computing capabilities greatly enhance such imagery to make analysis more effective in applications such as land use management, weather analysis, military surveillance, and mission planning and training.

Visualizing terrain, weather, and geologic data

Pixar's image computers provide programmable, high-resolution systems for rendering and image processing in remote sensing and mapping applications. For example, the ChapTerrains™ software package can be used to generate three-dimensional (3-D) terrain views from elevation data. The views can be sequenced together to create an animation that simulates flight over the terrain. Users can apply Pixar's ChapReyes™ surface rendering software to create 3-D animations of clouds and hurricanes from satellite weather data. And Pixar's ChapVolumes™ volume visualization software can be employed for applications requiring the display of geoscientific data in volumes, such as showing the location and size of mineral reservoirs. Additionally, Pixar's standard libraries of image processing routines can be used in image interpretation to enhance, transform, and analyze images.



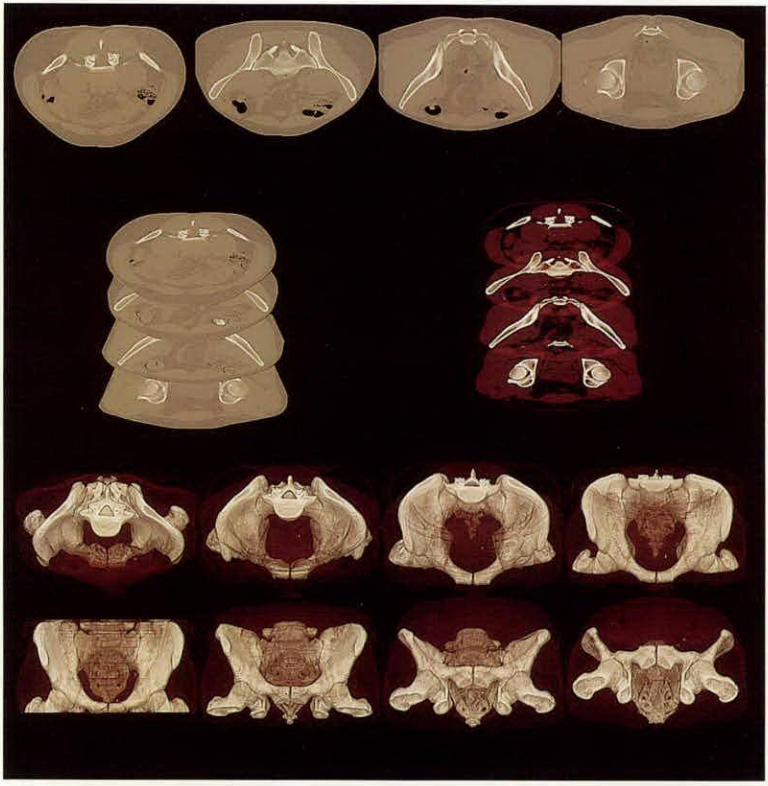
A single infra-red aerial photo with several image-processing functions performed on it. Clockwise from upper-left: 1) the original data, 2) after applying a Laplacian filter to enhance edge information, 3) the result of a routine that classifies land use based on color, 4) after running both an adaptive contrast enhancer and a sharpening filter to bring out the detail in the image.

Medical imaging applications

Until recently, technologies such as CT and MR scanning have limited orthopedic and neurosurgeons to 2-D images of internal structures and organs of patients. But with Pixar's image computers, the physician and radiologist can now see more accurate and detailed views of these images than ever before. It is a tool which significantly enhances the quality of medical diagnoses.

Animated, 3-D reconstructions of medical data

Using the volume rendering techniques of Pixar's ChapVolumes software, Pixar's image computers provide realistic, 3-D reconstructions of 2-D medical data from scans. The computer can be used to display the inside of structures, not just their surfaces, showing the object's thickness, internal contours, and subtle surface details such as nondisplaced fractures. Further, by creating animated sequences of images, Pixar's image computers can help physicians better understand complex spatial and depth relationships. Pixar's image computers also improve the quality of 2-D images available to physicians by providing enhanced contrast, edge sharpening, digital subtraction, and other advanced 2-D image processing techniques.



The top row shows several CT slices of the pelvic region of a patient. The slices are stacked, color and transparency are assigned, and then several views are generated as seen in the bottom rows. The 2-D black and white CT slices have been transferred into a more realistic and useful image of the pelvic region. Data courtesy of Dr. Elliot Fishman, The Johns Hopkins Hospital.

Applications in graphic arts, design and animation

Whether it's a graphic designer laying out a magazine page, an industrial designer presenting a new product design, or an animator creating special effects for the movies or television, the common requirement for all is high resolution. Pixar's image computers offer spatial and color resolution unequalled by any other machine.

Meeting the demanding requirements of print and film

Pixar image computers can be configured to store from 2 million to 32 million pixels. But these are not just ordinary pixels—each contains 48 bits, providing the capability to handle the color resolution required for print and film. And because such applications frequently require over-laying images to form a final frame or page, the computer can store mattes to allow the user to easily create complex multi-image layouts.

High-quality images generated in minutes

With the ChapReyes software package, Pixar provides the fastest high-quality surface-rendering package on the market. High-quality images of 3-D geometric models can be generated in minutes instead of the hours previously required. This speed and flexibility allows designers and animators more room for experimentation. It also makes it easier to make changes during the early design phase of a project, rather than having to wait for final images to be created.

A high-resolution photograph is shown here before and after it was quickly updated. Notice that the knife at the top of the original image was painted out and some of the fruit has had its color changed. The high resolution of the image computer maintained the quality of the image throughout this process.

Meet the Pixar image computer family

Pixar offers two compatible members of the image computer family: the Pixar II and Pixar Image Computer. Both serve as high performance platforms for Pixar's extensive image computing software.

Pixel-based architecture

Based on the data structure of the pixels themselves, Pixar's image computer architecture maximizes the speed at which pixel data can be accessed and modified. Utilizing a flexible, modular design, users can increase the performance and capability of the basic image computer systems with additional processors, image memory and video options. Both the Pixar II and Pixar Image Computer are based on the same pixel-based architecture, so that software written for one machine will run on the other, similarly configured.

Interface to host computers

While Pixar's image computers provide an optimized platform for the pixel processing functions required in image computing, a host computer is used to provide overall application management and user I/O. Pixar image computers can be interfaced with a wide range of host computers, from personal computers to supercomputers, enabling users to work with the host computer best suited to their application.

Pixar II is the new low-cost image computer with up to 108 megabytes of image memory and advanced video features. Its video display resolution is programmable up to 1280 x 1024. Users who require a low-cost Pixar platform, or who require the advanced video features, choose Pixar II.

The Pixar Image Computer is capable of maximum general purpose pixel processing power and up to 192 megabytes of image memory. Its video display resolution is 1024 x 768. Users who require the ultimate in image computing horsepower choose the Pixar Image Computer.

The Pixar II and its companion 19-inch color monitor can easily fit into an office environment.

Fast and flexible image computers

Pixar's image computers incorporate a unique architecture that delivers high-speed computation in a general-purpose image computer.

Flexible image memory

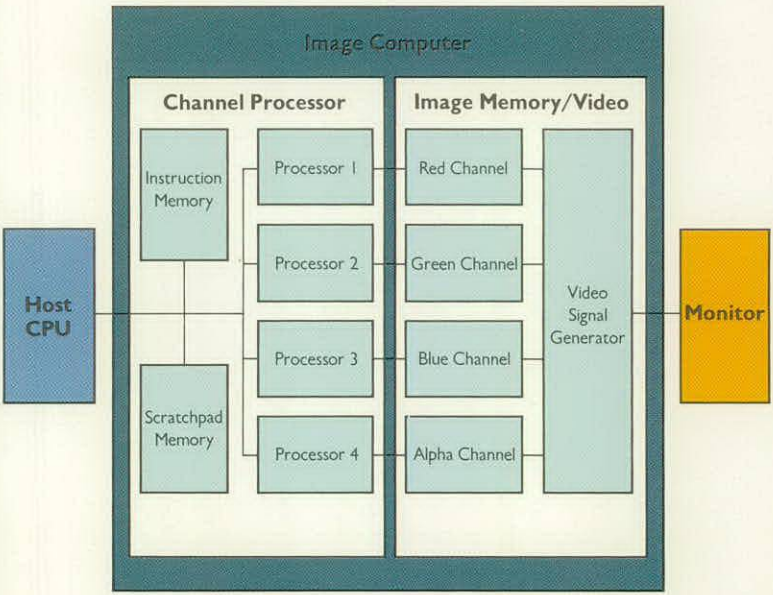
The image computer's memory can be configured to any size or aspect ratio to store images, datasets, or volumes of various sizes. The image memory is divided into four channels for the storage of color images. Alternatively, the memory can be configured as a single channel to efficiently store large monochrome images. All memory allocation and configuration is fully programmable, allowing users to instantly adapt to various size and resolution formats.

Built for high performance

The Pixar Channel Processor, or "Chap," employs a SIMD (single instruction, multiple data) design which synchronizes four parallel processors to operate simultaneously on the four memory channels. This parallelism is well matched to the needs of most computer graphics and image processing algorithms. Pixar image computers can be augmented with additional Chap processors for even greater performance.

Fully programmable

Like other general-purpose computers, Pixar's image computers are fully programmable and feature both high-level C language for ease of programming capabilities and low-level assembly language access for optimization.



This parallel architecture produces a high performance, programmable system optimized for image manipulation. Applications programs on the host CPU access the power of the image computer by first downloading the program into the instruction memory. Four processors then execute the same instruction simultaneously on multiple data, temporarily stored in the scratchpad memory. Processed pixel data is then quickly passed to the four memory channels for display.

Practical solutions to real-world requirements

Pixar has applied its technology to satisfy the precise needs of users' applications.

Full-color precision

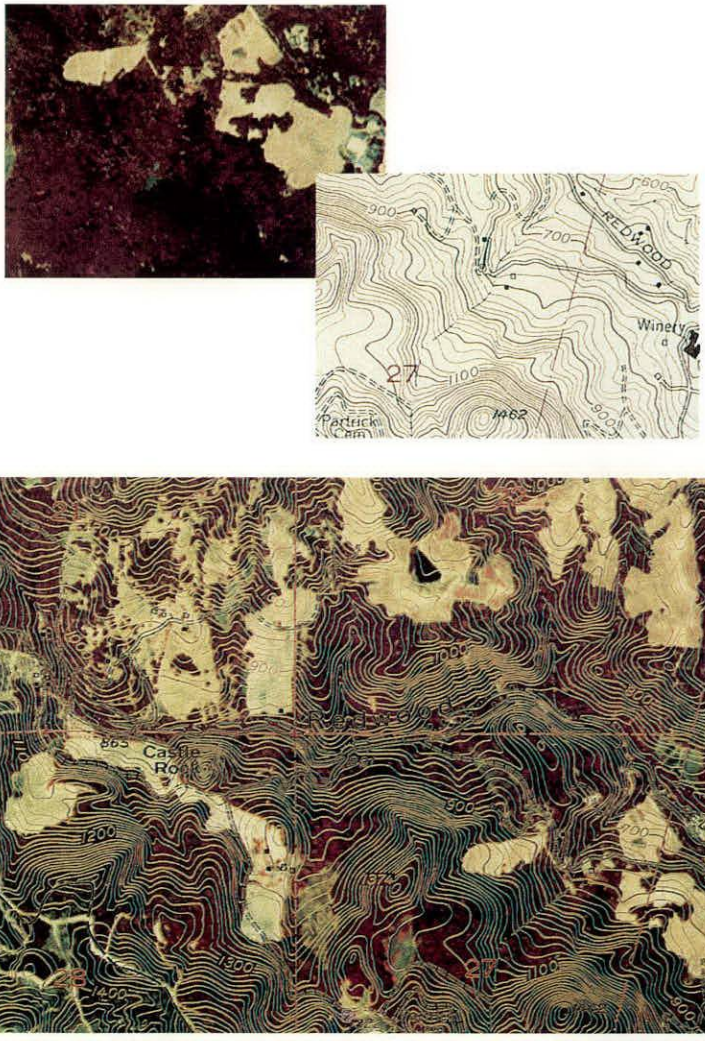
Color pixel data is represented in Pixar image computers in four 12-bit channels (red, green, blue, and alpha). This 12-bit precision is necessary to satisfy the demanding requirements of such applications as graphic arts and medical imaging, where subtlety and shading are critical to interpretation.

Alpha channel for added functionality

The alpha channel provides additional information at each pixel. A common use is to store transparency information for blending two images. In this case, the alpha value of a pixel describes the amount of a foreground image to display versus the amount of a background image that should show through. Pixar's ChapReyes surface rendering software package generates alpha values so that photorealistic images may then be composited.

Real-time image blending

A new video merge technology for aligning two images in real time is available on the Pixar II. Users can interactively overlay and compare two images, make them fade in and out of view, or interactively add and subtract objects from an image. Neither of the resident image data sets is disturbed in any way. Video merge uses the alpha channel to perform the image blending in real time.



Here an infra-red aerial photograph showing a region's vegetation and an image containing topological data for the same area are overlaid so that a user can visually correlate the data. The relative position can be interactively modified using a video merge.

Expandable to meet application needs

Both the Pixar II and the Pixar Image Computer are exceptional image computing platforms in their basic configurations. Field upgradeable option modules enhance them even further:

Additional Chap(s)
For increased processing speeds.

Additional Image Memory
For larger images, more images, longer film loops, larger volumes.

Parallel Transfer Disk Subsystem
Large capacity, fast disks for storing additional image memory data.

Monitors
High-resolution color and monochrome monitors.

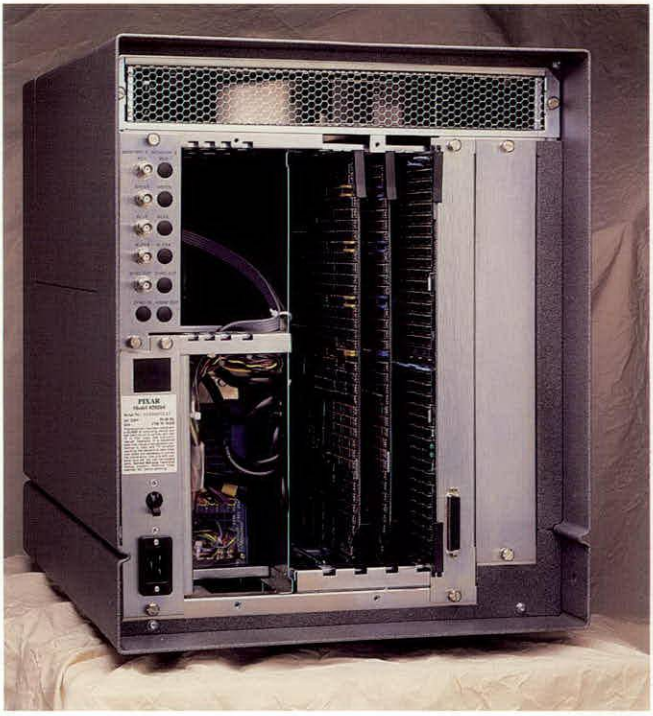
Dual Display Output
View two different images on two different monitors.

Genlock
For synchronizing the Pixar video signal to a video signal generated by an external device.

Video Merge
For real-time, non-destructive image aligning and alpha blending.

High Speed Interface
Allows systems integrators to add cameras, data acquisition devices, hard copy, and other devices requiring fast data I/O from a Pixar image computer.

Note: Pixar configuration guidelines detail which options are available in specific host and Pixar environments.



Modular packaging makes the Pixar II easy to configure.

Pixar software

The fully programmable Pixar II and Pixar Image Computer have three levels of software to aid users in developing image computing applications.

Program development tools

ChapTools™ offers a set of powerful programs, utilities, libraries, and resources for programming the Pixar image computers. The tools include the Chap C compiler, an assembler, a run-time monitor, and a dynamic loader. The Chap C compiler generates executable code from high-level C programs for execution on the image computer. It supports the standard Kernighan and Ritchie C programming language, with enhancements specific to the parallel architecture of the Pixar image computers.

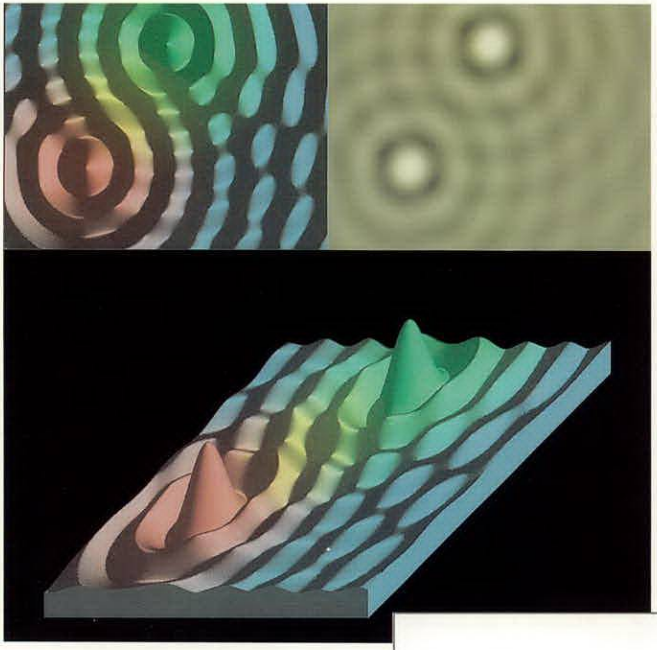
Run-time libraries

ChapLibraries™ is a set of utilities and run-time libraries for many basic 2-D and 3-D graphics manipulation and image processing tasks. ChapLibraries allows users to exploit the full power of Pixar's image computers without having to build their own image processing or computer graphics routines. ChapLibraries consists of functions for both high-level and low-level operations on the host computer and Chap channel processor. Functions are available for image processing, display, and input/output utilities. The libraries are accessible from C programs on the host computer. Many of the libraries are accessible as shell utilities, giving users immediate access to many common operations for image computing.

Software toolkits

Application toolkits generate high-quality images of three-dimensional volumetric data (ChapVolumes), terrain data (ChapTerrains), and geometric models (ChapReyes). The toolkits include libraries for data input, rendering, and image manipulation.

Pixar provides extensive reference and tutorial documentation for these software toolkits. In addition, Pixar distributes a variety of demonstrations, specialized functions, and images contributed by Pixar's customers and developers.



```
parallel int    line [512];
int             profile [512];

main () {
        register int xx, yy, zz, delta, lastz;
        int *fb, *pw;

        fb = (int *)AllocTB(0, 32, 128);
        pw = (int *)OpenPW(fb, 0, 1023, 0, 4095);

        for (yy = 383; yy >= 0; yy--) {
                FxSCopy(pw, line, 512, 0, yy);
                for (xx = 0;  xx < 512;  xx++) {
                        zz = line[xx].chan[3];
                        lastz = (xx < 511)? profile[xx+1] : -1;
                        delta = zz - lastz;
                        if (delta > 0)
                                /* Paint a vertical line.  The arguments are:
                                   pixel window, color, length, x and y. */
                                SFyClear(pw, &line[xx],delta, xx-yy+383, 768+yy-zz);
                        profile[xx] = ((zz > lastz)? zz : lastz) -1;
                }
        }
}
```

A Chap C program running on a Pixar image computer uses a moving horizon algorithm to generate an orthographic projection of the plot for a mathematical function. The values of the function for each x, y location is stored in the alpha channel which can be seen in the upper right. A shaded color version of the function is stored in the R, G and B channels which can be seen in the upper left. The projection was generated in five seconds. The ability to program a Pixar image computer using the widely known C language allows specific applications to be easily and quickly developed.

Volume rendering

Typically, much engineering, scientific and medical data is volumetric data, represented as a three-dimensional array of coordinates where each coordinate has a value which represents the effect of a phenomenon at that point. Examples include astrophysical and geophysical measurements, structures within the human body, stress patterns in materials, and fluid flow.

Pixar pioneered a new technique called volume rendering which renders volumetric data. The benefits of this technology are available in Pixar's ChapVolumes software package, which allows users to visualize many types of real-world and computer-generated data. ChapVolumes provides accuracy not possible with previous techniques for rendering scientific, medical and engineering data.

Render internal structure of images

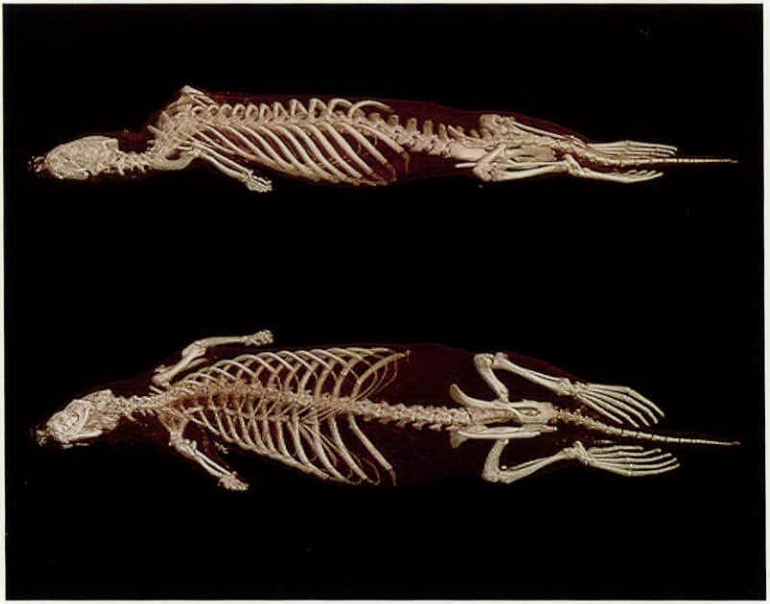
Traditional computer graphics techniques for projecting volumes use lines or polygons to approximate the edges or surfaces of a volume. With ChapVolumes, however, users can now view three-dimensional structures—such as an energy distribution or turbulent fluid flow—which cannot be defined accurately by surfaces. And because volumetric data often has essential internal information, ChapVolumes provides image rendering that captures the contents of each point in the data. This allows the user to display images that reveal important details about the interior of a structure.

Project a more accurate rendition of volumetric data

Because ChapVolumes retains all of the volumetric characteristics and visual cues of the data, users can view a true representation of the original volume, including internal make-up, spatial relationships, and thickness and depth. In addition, ChapVolumes retains subtleties in the original volume, such as small cracks in components or irregularities in material composition.

Rotate and view a volume from different angles

Viewing a volume from different angles shows features that may be obscured from another angle. In addition, motion gives more definition to three-dimensional objects, helping the viewer perceive depth, and bringing out objects that might go unnoticed in a static image.



Whole body reconstruction of the musculoskeletal system of a sea otter from over 400 CT slices. This enables the biologist to learn more about the skeletal system of the sea otter, particularly the structure of its extremities. Data courtesy of Dr. Michael Stoskopf, The Johns Hopkins Hospital.

Terrain rendering

With Pixar's ChapTerrains software package, users can generate three-dimensional perspective scenes of terrain elevation data or other height fields. In addition, ChapTerrains provides the capability to generate animated sequences and create "fly-bys" over the terrain scene. ChapTerrains can be used in applications such as geographic information systems, mission planning and training, image interpretation, medical imaging, and scientific visualization to prepare high-quality views of elevation and image data.

Realistic, perspective terrain views

In remote sensing and mapping applications, ChapTerrains takes digital terrain elevation data, supplied as a grid of altitudes for a geographic area, and generates a highly realistic, full perspective view of the terrain. ChapTerrains can also map a color or monochrome image of the landscape onto the elevation data. Anti-aliasing is used on the resulting image to eliminate jagged edges and to avoid "sparkling" mountain peaks, which can appear when flying over computer-generated terrain.

ChapTerrains can also be applied in medical imaging for applications such as viewing distortions of the back inside surface of the eye, and in scientific visualization for applications such as viewing temperature or pressure fields.

High performance features

Rendering speeds with ChapTerrains average 15 seconds for a 512 x 512 scene, using full perspective, anti-aliasing, hidden surface removal and mapping a color image onto the rendered elevation data. The parallel architecture of the Pixar image computers contribute to the speed of ChapTerrains. The Chap can process both height and image data simultaneously allowing ChapTerrains' underlying rendering algorithms to be performed in parallel, yielding faster results. In addition, the large image memory allows the source terrain data to be processed from memory rather than disk, contributing to ChapTerrains' performance.

This perspective view of Castaic Lake and surrounding hills north of Los Angeles was quickly generated using ChapTerrains. Its use of high-quality rendering techniques, such as anti-aliasing and bicubic resampling, contribute to the realism of this scene. Data courtesy of Jet Propulsion Laboratory.

Realistic surface rendering

ChapReyes is Pixar's software package that provides fast, high-quality image synthesis. It includes many of the innovations in image synthesis pioneered by Pixar. This powerful tool is being applied to graphic arts, product design, broadcast and industrial television, simulation and three-dimensional visualization.

Techniques for achieving realism

Many techniques are available with ChapReyes software to achieve greater realism in rendering geometric models.

Anti-aliasing Supersampling up to 64 samples per pixel eliminates jagged edges.

Texture maps Provide models with realistic surface textures.

Environment maps Global scene reflections put models into a realistic environment.

Light sources Control of color, strength, direction and locality of up to 32 light sources allows realistic scene lighting.

Shading A choice of shaders including flat, Phong, and Gouraud provides accurate models of light reflections from surfaces.

Impressive rendering speeds

ChapReyes generates these high-quality images at speeds up to 50 times faster than a typical graphics workstation. Rendering speeds can average 50,000 to 100,000 polygons per minute, for example, in scenes using multiple light sources, Phong shading, texture maps, environment maps, and translucency. For quick previewing during the design cycle, higher speeds can be achieved by deactivating anti-aliasing, using flat shading, increasing polygon size and lowering resolution. ChapReyes with three Chaps runs almost 3 times faster than with a single Chap.

Integration

ChapReyes may be integrated with external modelers through a high-level C-subroutine interface. This interface supports a large variety of image description, storage, and transfer formats. ChapReyes' high-quality rendering may also be integrated with other Pixar functions, such as compositing, to produce seamless montages, composite images, and animations.

This image of a T-45 trainer plane, rendered by ChapReyes, uses an environmental map that allows the plane to reflect the surrounding clouds and the terrain below, providing a valuable touch of realism to the image. Model courtesy of Wavefront Technologies.

Third party solutions

As an ongoing commitment to its customers and users, Pixar maintains a third party developer program, *Pixar Producers*, to assure that useful and innovative software application solutions and add-on hardware are available for the Pixar image computer family.

Leading developers in the program

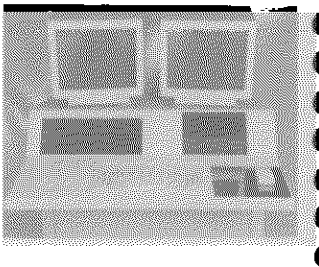
The Pixar Producers program includes leading software development companies such as ERDAS, DBA Systems, Time Arts, Terra-Mar, Hannaway & Associates, Intelligent Light, Decision Images, Media Cybernetics, and MPDI and leading peripheral suppliers such as Stereographics and Focus Graphics, Inc. These developers provide end-user application solutions in the areas of remote sensing and image processing, medical imaging, design and animation, and scientific and engineering visualization, and such peripherals as stereo viewing systems and film recorders.

Support for applications software and hardware

Pixar supports third party vendors in integrating their products with Pixar's image computers and then helps increase the visibility of these products in Pixar's marketplace. Each quarter, the *Pixar Producers Catalog* is published listing all the products available or under development through the Producers program. The catalog represents an effort by Pixar, and its third party software and hardware vendors, to provide a comprehensive and accessible listing of products available for Pixar's image computers and their host systems.

Complete turnkey solutions

Pixar also encourages development by OEMs and value-added resellers (VARs) to provide turnkey hardware and software solutions. A significant and growing number of companies are taking advantage of the market opportunities for image computing and are providing end-user solutions based on Pixar's products. One notable example is Philips Medical Systems' PICS 2000 system for radiologists offering volumetric reconstruction of CT data.



Philips PICS 2000 system.

Sales and technical support

Pixar maintains a nationwide sales and service organization with offices in major cities throughout the United States and distributors throughout the world. We are able to offer our customers extensive support, including:

Needs Analysis
System Integration
Training
System Optimization
Ongoing Maintenance
Remote Diagnosis
Replacement Parts
Software Support
Custom Application Development

Special sales and service plans are available for volume installations, VARs and OEMs.

Please contact your local Pixar sales office or Pixar headquarters for more information. We look forward to working together to bring the benefits of visualization to your application.

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Glossary

Computer Graphics The process of creating an image on a computer screen built up from geometric primitives such as lines and polygons. "Drawing" with a computer.

Computed Tomography (CT) A diagnostic technique that creates a cross-sectional view of an object (such as a human body) by passing X-rays through the object from many different angles.

Graphics Workstation Provides real-time processing of 3-D data by representing objects as geometric models or wireframes.

Image Computer Provides both general purpose computer graphics and image processing power in a single system.

Image Processing Using a computer to manipulate or enhance real or synthetic images such as provided by a video camera, a CT scanner, or a satellite.

Image Resolution The size of an image as measured by number of pixels in the horizontal and vertical directions.

Image Synthesis The generation of an image from a mathematical model.

Parallel Processors A group of computer processing elements which operate all at the same time; as opposed to sequential or "pipelined" processor, which must wait for some other processor to complete a task before it can commence operating. Parallel processors can significantly reduce computing time.

Pixel (Picture Element) The smallest definable area of a 2-D image which is capable of being displayed.

Raster Data (Image Data) The representation of an image by storing its intensities or colors as a regular 2-D grid of pixels. Raster data images are distinct from wireframe images, where line drawings are stored by saving only the endpoints of the lines.

Rendering The generation of an image from a digital representation.

Scientific Visualization Allows a scientist to see on a screen a representation of numerical data generated by another source, that would otherwise be more difficult to comprehend.

Screen Resolution For raster display systems, the number of pixels per scan line, by the number of scan lines.

Volume A three-dimensional array of raster data.

Voxel (Volume Element) A three-dimensional pixel.

SALE
Clearance

You are invited to an
Exclusive Briefing
[illegible] SIGGRAPH press only
on

Pixar's RenderMan™ Interface for Photorealism

■

Wednesday, August 3, 1988
Omni Hotel, 100 CNN Center, Glenmar A
Atlanta, Georgia

9:15 a.m. Press Briefing
or
1:15 p.m. Press Briefing

■

Pixar is hosting a two-hour seminar for developers immediately following the press briefings. RenderMan technology demos will be shown; you are welcome to attend.

10:00 a.m. Developers Seminar
2:00 p.m. Developers Seminar

RSVP to Joy Folla at 415-258-8100.
Please call if you have any questions.

The power of the RenderMan Interface enables the description of photorealistic objects and scenes such as this frame from Pixar's film *Red's Dream*.
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